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The patterns of homicide offence characteristics and their associations with offender psychopathology

Previous research suggests different crime scene patterns reflect differences in the background characteristics of the offender. However, whether differences in crime scene patterns are related to offender psychopathology remains unclear. We hypothesise that schizophrenia, bipolar disorder and depressive illness will each associate to a specific homicide crime scene pattern. Homicide data were obtained from the National Confidential Inquiry into Suicide and Homicide by People with Mental Illness. Our sample comprised 759 homicides committed by offenders in contact with Mental Health Services in the year preceding the offence and with an available psychiatric report. We used Joint Correspondence Analysis to examine patterns between different methods of homicide, circumstances of homicide, victim gender and victim age groups. Three homicide patterns were identified: male conflict homicide, intimate female homicide and child homicide. Additionally, each homicide pattern was associated with one or more mental illnesses. Results are discussed in terms of the possible role of psychopathology in 'offender profiling' research.

Keywords: Homicide characteristics, Crime-scene patterns, Multivariate analysis, Psychiatric diagnosis, Offender profiling

1. Introduction

Studies analysing crime-scene behaviour and offenders' characteristics attempt to answer the question 'what kind of person commits what kind of crime?' (Khoshnood & Väfors Fritz, 2017; Liem et al., 2013; Santtila, Häkkänen, Canter & Elfgrén, 2003). The manners in which a crime may be committed¹ can be classified (e.g. categories of methods of homicide) and are thus amenable for analysis (Jackson & Bekerian, 1997). The aim of offender profiling is to derive inferences on significant characteristics of an offender based on details from the crime scene and the victim.

There are broadly three approaches to offender profiling: the criminal investigative approach, the clinical practitioner approach and the scientific statistical approach (Muller, 2000). In the first two, inferences were attributed to the skills, knowledge and experience of the 'profiler', rather than to scientific research (Alison & Canter, 1999; Canter, 2011). Thus, these studies showed weakness in methodologies through lack of convincing empirical evidence (Canter, 2004; Muller, 2000). Indeed, a high proportion of offender profiles have been shown to be unsubstantiated (Alison, Smith, Eastman & Rainbow, 2003). However, more recent research has taken on a statistical approach (i.e. behavioural investigative advice) based on multivariate analysis of crime scene information to infer offender characteristics and psychological processes (Canter, 1995). Some evidence suggests that the behaviour committed at the crime scene by homicide offenders is linked to their past behaviour and background characteristics (Canter, 2011; Salfati & Bateman, 2005; Salfati, 2000; Trojan & Salfati, 2010). Identifying patterns among homicide crime scene characteristics through such behavioural analytic approaches may assist criminal investigations in (1) suspect

¹ Modus operandi of the offender

prioritisation, (2) crime linkage, (3) clinical understanding of offences and (4) risk assessment of offenders in clinical settings (Alison, Goodwill, Almond, van den Heuvel & Winter, 2010).

The starting point to any study investigating consistency between offence and offender characteristics is to analyse crime scene information. Previous research has taken two approaches when analysing crime scene information. Both approaches aim to contribute to police homicide investigations and assist in suspect prioritisation (Salfati & Canter, 1999).

1.1 Approaches to offender profiling

1.1.1 Crime scene actions as unit of thematic analysis

The first approach encompasses a psychological framework to understand homicide through the thematic analysis of detailed crime scene actions. Examples of these include the offender covering the body, stabbing multiple areas of the body, blindfolding the victim, etc. (Salfati, 2003; Santtila et al., 2003). Information on crime scene actions is usually obtained from police databases maintained for operational purposes, not validated or updated regularly, and hence their accuracy is questionable for research purposes (Bennell & Canter, 2017; Bijleveld & Smit, 2006). Most studies following this approach have used a theoretical distinction framework useful to identify and classify themes of aggressive behaviours reflected in different crime scene actions (Gerard et al., 2017; Salfati & Canter, 1999; Salfati & Park, 2007; Santtila, Häkkinen, Alison & White, 2003). Indeed, previous analysis of crime scene actions confirms that the behaviour of individuals committing homicide is not random, but rather indicative of the psychological mechanism underlining the homicide (Elfgren & Häkkinen, 2001; Salfati, 2000; Salfati & Haratsis, 2001; Santtila, Canter). However, analysis of crime scene information may involve not just behavioural information, but other aspects of the

crime that are available at the beginning of an investigation, such as information about the victim, and the location and time of the homicide.

1.1.2 Official homicide data as unit of analysis

The second approach involves using official homicide databases to assist in police investigations by predicting offender profiles based on more general victim and offence characteristics, such as victim age and location of homicide (Francis et al., 2004; Wolfgang, 1958). These investigations use the offence aspects of the homicide (e.g. victim information) as a unit of analysis, rather than crime scene actions (Santtila et al., 2003). For example, an early study by Wolfgang (1958) reported male victims were more likely to be killed by a friend, while female victims were mostly killed by a family member. Additional studies have indicated victim characteristics may predict information about offender characteristics, such as the relationship between victim and perpetrator (Karlsson, 1999).

More recently, a study by the Home Office (2004) explored whether victim and offence characteristics contained in the Homicide Index can assist in predicting offender characteristics and contribute to police investigations using predictive statistical modelling techniques (Francis et al., 2004). The study used victim and offence characteristics as predictors of offender characteristics. Findings indicate the circumstance of the crime, method of homicide and victims' age and gender as significant in accurately predicting the age group of the offender (Francis et al., 2004). Unfortunately, the researchers did not specify whether their sample included offenders with a mental illness. Indeed, the idea that severe violence may differ with regard to the offenders' diagnostic group has been relatively ignored among homicide offender profiling studies (Häkkinen, 2007). However, recent research has

shown some offenders with serious mental illness have unique patterns of offending (Peterson et al., 2010).

The present study is unique in that it aims to combine both approaches by focusing on one crime scene action (method of homicide used) and three offence characteristics (circumstance of homicide, victim age and victim gender) that have been previously identified as useful when predicting offender information (Francis et al., 2004). Furthermore, we will examine whether these four offence characteristics differ among individuals with different psychiatric diagnoses.

1.2 Crime scene characteristics in homicides committed by individuals with mental illness

Previous research indicates homicide investigators need advice on whether a particular case includes behaviours prone to offenders with a mental illness (Häkkänen, 2007). Increasing studies focusing on the manifestation of offender psychopathology on specific homicidal crime scene behaviours suggest violence in psychiatric patients is related to the underlying psychopathology (Krakowski, Volavka & Brizer, 1986; Steury & Choinski, 1995). This led Häkkänen (2007) to propose that future research should focus on samples of homicide offenders with mental illness to establish whether specific offence characteristics might be linked to a particular psychiatric disorder. Findings have shown that homicide offenders with and without a mental illness differ from each other in their offence, demographic and background characteristics (Häkkänen, 2007; Oram et al., 2013). For example, offenders with mental illness are less likely to have strangers as victims (Shaw et al., 2004), more likely to be older (Martone et al., 2014) and have more problematic backgrounds (Laajasalo & Häkkänen, 2004) compared to offenders without a mental illness. Furthermore, research also suggests

specific homicidal crime scene behaviours may be indicative of a particular mental illness (Catanesi et al., 2011; Häkkänen, 2007; Rodway et al., 2009). Overall, findings showed that method of homicide, victim gender and relationship between victim and offender differed among diagnostic groups (Häkkänen & Laajasalo, 2006).

Specifically, schizophrenia and psychosis have been associated with the use of sharp instruments in a homicide (Hughes, Macaulay & Crichton, 2012; Steury & Choinski, 1995). Possibly due to their immediate and easy availability (Joyal et al., 2004), as well as individuals with schizophrenia being more likely to carry easily available weapons with them in response to paranoid thinking (De Zulueta, 2006; Meehan et al., 2006). Moreover, a recent review on homicide methods used by individuals with mental illness (Abreu Minero et al., 2017) reported over half of individuals with schizophrenia killed a family member by stabbing in four out of the nine studies included in the review.

Regarding bipolar disorder and depression, Rodway et al., (2009) reported a link between affective disorders and the use of strangulation/suffocation, and depression and asphyxiation/suffocation/drowning used as methods of homicide. Recently, increasing studies have reported these methods as the most frequently used among offenders with affective disorders (Catanesi et al., 2011; Rodway et al., 2009; Yoon et al., 2012). A possible explanation for this link may be drowning/suffocation/asphyxiation are more likely to be used by female offenders (Flynn, 2013). Indeed, studies have consistently reported high rates of affective disorders among female homicide offenders (Flynn et al., 2013). Specifically, strangulation was significantly more likely to be used on victims over 65 years (Rodway et al., 2009), while drowning/suffocation/asphyxiation were significantly more likely to be used by

female offenders to kill young children (Catanesi et al., 2011; Rodway et al., 2009; Yoon et al., 2011).

Only a few studies have characterised the homicidal acts committed by individuals with personality disorders. A possible explanation may be the low diagnostic reliability of personality disorders, compared to other diagnoses (e.g. schizophrenia) (Hodgins & Müller-Isberner, 2000). Overall, research seems to suggest similarities with the homicidal characteristics of those with alcohol dependence: impulsive acts preceded by arguments, use of violent methods (e.g. kicking/hitting, blunt instrument) and acquaintances as primary group of victims (Häkkänen & Laajasalo, 2006; Rodway et al., 2009). Moreover, alcoholism has been found to be prevalent among homicide offenders with personality disorders (Fazel & Grann, 2004; Tiihonen et al., 1993). On the other hand, homicides by offenders with drug dependence have been found to have similar characteristics to those committed by individuals with schizophrenia (Häkkänen & Laajasalo, 2006) and linked to poisoning as a method of homicide (Rodway et al., 2009).

Some studies have also reported links between a motive (e.g. revenge) and a mental illness (Putkonen et al., 2001). Catanesi and colleagues, (2011) found a strong association between a schizophrenia diagnosis and persecution as a motive, while personality disorders associated with an impulsive reaction at the time of the offence. However, a frequent limitation in these studies is that information is not always obtained from data collected for research purposes (e.g. police written reports, offender self-reports), this may result in relatively large amounts of missing data (Häkkänen, 2007; Hughes et al., 2012). Additionally, sample size in most studies was small to moderate (Catanesi et al., 2011; Hughes et al., 2012; Putkonen et al., 2001).

To date, previous studies have concentrated exclusively on describing the differences of crime scene characteristics across psychiatric diagnoses (Rodway et al., 2009; Häkkänen & Laajasalo, 2006), identifying bivariate associations (e.g. between a single crime scene variable and a single mental illness) (Steury & Choinski, 1995) or making inferences on homicide behaviours based on characteristics such as motive, prior convictions of the offender and psychiatric diagnosis (Häkkänen & Laajasalo, 2006). However, these studies are of limited use to police investigations, since they usually include in their analysis offender information that is not available to the police immediately following the crime (Santtila et al., 2003). Indeed, any valid inferences made about an offender are required to be based on information available at the beginning of a homicide investigation (e.g. method of homicide used, the victim gender, location of the crime, evident crime scene actions) (Canter, 2000). Nonetheless, information on psychiatric diagnosis may be useful at the later stage of analysis; linking crime scene information with offender characteristics (Santtila et al., 2003).

1.3 Present research

Overall, there are three main limitations with existing literature on crime scene analysis. First, investigations that use multivariate statistics to identify patterns of homicide behaviour tend to have small samples and/or fail to provide mental illness rates of the offenders included (Salfati & Dupont, 2006). Second, most studies that do specify differences in diagnostic groups among offenders with a mental illness focus on bivariate relationships between offence and offender (e.g. between method of homicide and a specific mental illness) (Catanesi et al., 2011; Hughes et al., 2012; Rodway et al., 2009) and therefore do not take into account the dynamic context of the homicide. In other words, most studies that do include offenders with a mental illness lack a multivariate approach which enables the identification of patterns of

offence characteristics that are specific to homicides committed by mentally ill offenders. Third, the majority of studies obtain information about the homicide from police reports, hence data may be incomplete and lack consistency across studies (Bennell & Canter, 2017; Canter, 2011).

Our study will address these limitations by a) using more suitable homicide data collected for research purposes (official homicide statistics and homicide questionnaires) and b) conducting multivariate statistical analysis in order to identify any patterns specific to homicides committed by individuals with mental illness. In line with existing research, we will use four previously identified offence characteristics significant in predicting offender information: method of homicide, main circumstance of the crime, victim age and victim gender (Francis et al., 2004). The present study has two overall aims. The first is to investigate whether offence characteristics in a sample of homicides committed by individuals with mental illness are structured in an interpretable way that is useful for homicide investigations. The second is to examine the relationship between the identified patterns and the psychiatric diagnosis of the offender before committing the homicide. Based on previous findings, we hypothesize that schizophrenia will associate with a homicide pattern describing domestic homicides committed with sharp instruments against blood relatives (Abreu Minero, Barker & Bedford, 2017; Häkkänen & Laajasalo, 2006). Bipolar disorder will associate to a pattern concerning homicides committed using strangulation/suffocation against a family member or partner/ex-partner (Matejkowski et al., 2005; Rodway et al., 2009; Yoon et al., 2012). Finally, depressive illness will associate to a pattern delineating homicides committed using drowning/suffocation/asphyxiation against a young son/daughter (Flynn, 2013; Catanesi et al., 2011).

2. Method

2.1 The data

All data were obtained from the National Confidential Inquiry into Suicide and Homicide by People with Mental Illness (NCISH). NCISH collates and manages a large dataset containing information on homicide offenders diagnosed with mental illness in the UK since 1997. The method of data collection of NCISH had three stages (Appleby et al., 2016; Shaw et al., 2006). First, the names of individuals convicted of homicide (murder, manslaughter, infanticide, not guilty by reason of insanity or unfit to plead) in England and Wales were received from the Home Office, which routinely collects this information. Second, psychiatric reports prepared for court were requested from the courts of trial, the Crown Prosecution Service and The Prison Service (Shaw et al., 2004). Psychiatric reports provide information on clinical history, mental state at the time of the homicide, alcohol/drug misuse and history of violence. Third, identifying details of the offender were submitted to the main hospital and community trust in the perpetrator's district of residence in order to check for past treatment. Where contact with services was identified, detailed clinical data were obtained via questionnaires sent to the consultant psychiatrist who had been responsible for the patient's care and treatment (NCISH, 2017). The questionnaire includes information on psychiatric diagnosis, clinical history, aspects of care and details of final contact with mental health services. Questionnaires sent to consultant clinician had a 95% overall return rate (NCISH, 2017).

This large and unique database has been running for over 20 years and has a tried and tested methodology. The NCI examines the circumstances of homicide events in order to make recommendations on prevention of adverse outcomes, as well as improving safety in mental health care (NCISH, 2017).

2.2 The sample

There were a total of 10,473 people convicted of homicide in the UK between 1997 and 2014. To explore the associations between psychopathology and patterns of homicide, the final sample consisted of 759 patients in England and Wales who had been in contact with mental health services within 12 months of the offence and who also had undergone a psychiatric assessment at the request of the courts following the homicide. Therefore, the definition of homicide offenders with mental illness used in this study is quite restrictive and not comparable to previous NCISH studies (Flynn, Rodway, Appleby & Shaw, 2014; Rodway et al., 2009; Shaw et al., 1999). This sample was selected to include offenders with clinical information regarding the care received in the year before the offence to inform a future paper in this series.

Logistic regression analyses were conducted to examine socio-demographic differences among individuals who were (n=759) and were not (n=9,714) included in our study. The significance level for the logistic regression analyses was set at 0.05. Homicide offenders included in the present study were less likely to be male (OR=0.71, 95% CI (0.517, 0.979)), to have been in employment (OR=0.428, 95% CI (0.292, 0.626)), but more likely to be living alone (OR=1.53, 95% CI (0.1.17, 2.01)) and have had a history of alcohol misuse (OR=1.36, 95% CI (1.07, 1.72)) or drug misuse (OR=1.67 95% CI, (1.30, 2.15)).

2.3 Definition of variables

Four homicide offence characteristics previously identified as useful in predicting offender information (see Francis et al., 2004), were selected for the present study: 'victim gender', 'victim age', 'main circumstance of the offence', and 'method of homicide'. 'Victim gender' contained two categories. 'Victim age' contained six categories ranging from 0 to 91 years

old. The variable 'main circumstance of the offence' was derived from the Homicide Index and it contained eight categories, as previously defined by the Homicide Index (Francis et al., 2004). Finally, 'method of homicide' contained eight categories based on previous research by Rodway (2009) on methods of homicide by mentally ill offenders. See Table 2 for information on the homicide offence categories.

One additional variable named 'psychiatric diagnosis' containing seven categories of mental illness (see Table 1) was used to examine associations with the homicide offence characteristics. The psychiatric diagnosis of the offenders was derived from the diagnosis recorded in the homicide questionnaire completed by mental health services and/or the clinician responsible for the patient's care preceding the offence. In cases where the offender had a dual diagnosis, the primary diagnosis was the only one included in the analysis. For example, when an offender had schizophrenia and drug dependence, schizophrenia would always be considered the primary diagnosis

2.4 Statistical Analyses

The study contained two analytic steps. In step 1, we performed a Joint Correspondence Analysis (JCA) on 24 homicide offence characteristics to examine the multivariate relationships between the categories of: victim age, victim gender, method of homicide and main circumstance of the homicide (See Table 2). JCA is a variant of Multiple Correspondence Analysis (MCA). MCA is analogous to principal component analysis; it is an exploratory multivariate technique that allows the pattern analysis of the associations between more than two multi-level categorical variables (Joyal, Cote, Meloche & Hodgins, 2011). JCA produces a graph based on meaningful underlying latent dimensions that capture most of the inertia (Goodwill et al., 2014; Greenacre, 2013). Inertia indicates the amount of

variance explained by the solution (Goodwill et al., 2014). Each point in the graph represents a category in the analysis (Husson & Josse, 2014). Points located in close proximity to one another are considered more similar than distal points, and thus, may be indicative of theoretically meaningful associations (Abdi & Valentin, 2007; Goodwill et al., 2014). In general, the further a category is from the origin, the more distinct it is. Categories that are located near the origin are either shared by many individuals or not part of a discernible pattern; indicating that the technique has trouble identifying unique characteristics for them (Bijleveld & Smit, 2006). This method is well suited for non-normally distributed variables and has previously been used in studies investigating thematic classification of homicides (see Bijleveld & Smit, 2006; Goodwill, Allen & Kolarevic, 2014).

In step 2, we included the psychiatric diagnoses of the offenders as supplementary information in the JCA analysis. Supplementary variables are used to establish associations with the patterns identified from the JCA graph based on distances between points (categories that are closer to supplemental variables have greater correspondence) (Bijleveld & Smith, 2006; Greenacre, 2010). This was done by projecting the diagnoses onto the dimensions of the JCA graph. All analyses were performed using STATA Version 11 (StataCorp, 2009).

3. Results

3.1 Sample characteristics

Among the 759 offenders, 685 (84%) were male and only 123 (16%) were female. The mean age of the offenders was of 33.8 years (SD = 11.5). Frequencies and percentages of background and clinical information are presented in Table 1. In the present study, 97%

(n=735) of homicides involved one victim, 2% (n=19) of homicides involved two victims, and 1% (n=5) involved three victims or more. Where there were multiple victims, information on the first victim only was included. The first victim in the dataset is assigned by the Home Office when they add a case to the Homicide Index database. Of the 759 victims, 59% (n=447) were male, and 41% (n=312) were female. The mean age of the victims was 42.2 years (SD = 19.6). Table 2 contains information on frequencies and percentages for all homicide offence characteristics.

3.2 Joint Correspondence Analysis

A total of 24 homicide offence characteristics (see Table 2) were subjected to a two-dimensional JCA. The overall fit of the model was good, accounting for 85.5% of the total inertia. The JCA plot (Figure 1) depicts the underlying structure of 24 homicide offence characteristics. According to previous research (Bijleveld & Smit, 2006) the solution can be interpreted by examining emerging patterns while moving clockwise through the outer edge of the plot; the more central categories are not interpreted for this type of analysis as they are considered to not form part of a specific pattern or factor. Interpretation of proximity between homicide offence characteristics can be divided into two cases. First, proximity between categories of different variables (e.g. method of homicide and victim gender) indicates that these categories are likely to co-occur together in the homicides. Second, since categories of the same variable (e.g. method of homicide) are mutually exclusive (e.g. a victim is either stabbed or suffocated), the proximity between categories of the same variable indicates that the homicides associated with these two categories are themselves similar (Abdi & Valentin, 2007).

The analysis of the JCA plot (see Figure 1) revealed three distinct patterns of homicide offence characteristics:

Pattern of male conflict homicide: following the plot from the bottom of the left-hand side (highlighted in blue), involving homicides of young male victims between 15-24 years of age. These victims died as a result of kicking or hitting, and the main circumstance of the homicide was a fight, argument or dispute.

Pattern of intimate female homicide: moving clockwise (highlighted in pink), a second pattern involving homicides of female victims aged over 55 years was identified. In these homicides, the method of homicide used was strangulation and the main circumstances were a domestic dispute or irrational act.

Pattern of child homicide: moving to the right (highlighted in green), a third pattern describing child homicide was identified. These homicides involved children aged between 0-14 years as victims killed by the methods of drowning/suffocation/asphyxiation. The main circumstance of the homicide was child abuse.

3.3 Supplementary variable analysis of psychiatric diagnoses

The second aim of this study was to investigate if the identified homicide offence patterns relate to the offenders' psychiatric diagnosis before committing the offence. Figure 2 displays the supplementary analyses involving the psychiatric diagnoses. The diagnoses were plotted in a spatial relationship to the identified homicide offence patterns from the JCA in Figure 1. Across the y-axis, psychiatric diagnoses ranged from personality disorder, alcohol dependence and drug dependence on the bottom to schizophrenia/other delusional disorders on the top of the graph. Moving to the right, affective disorders diagnoses

(depressive illness and bipolar disorder) were located. The diagnosis 'other disorder' is placed centrally, suggesting this category was not associated with one specific homicide pattern.

First, the cluster of 'alcohol dependence', 'drug dependence' and 'personality disorder' in Figure 2 corresponded spatially in Figure 1 to the pattern of *male conflict homicide*. Therefore, these three psychiatric diagnoses are related to offenders that more often kill young males by the methods of kicking or hitting in the context of a fight or argument. Second, the diagnosis of 'schizophrenia/other delusional disorders' overlapped with the pattern of *intimate female homicide*. This indicates that this diagnosis associated with offenders that tend to kill older females by strangulation in the context of a domestic dispute or an irrational act. Third, the diagnoses 'depressive illness' and 'bipolar disorder' overlapped with the pattern of *child homicide*. Thus, affective disorder diagnoses were associated with homicides in which the victim was a child aged 0 to 14 years killed by drowning/suffocation/asphyxiation in the context of child abuse. Finally, the psychiatric diagnosis of 'other/unknown' was not associated to a specific pattern. This category was placed in the centre of the plot displayed in Figure 2, and therefore not close to any particular pattern. Possibly due to the category not being specific enough to identify a relationship since it encompassed seven different diagnoses.

4. Discussion

To the best of our knowledge, this is the first study to use a multivariate approach to analyse offence characteristics and their associations to mental illness in a sample of convicted homicide offenders. The overall multivariate analysis first showed that homicide characteristics can be separated into patterns of relationships that may provide valuable insight for forensic crime scene evaluation. We identified three patterns of homicide offence

characteristics: a pattern of male conflict homicide, a pattern of intimate female homicide, and a pattern of child homicide. As hypothesised, our findings show that homicide offence characteristics are associated with specific types of psychiatric diagnoses, with each crime scene pattern relating to one or more diagnostic categories.

The present study differs from previous research in type of analysis as well as type of data (i.e. incarcerated population vs crime scene data) and these differences will make direct comparisons with results from previous studies difficult. However, our study is similar to previous research in that the aim is to provide information that may assist crime scene investigators in suspect prioritisation (Santtila et al., 2003). The present results extend current knowledge in four ways.

First, the *male conflict homicide* pattern was associated with personality disorder, alcohol and drug dependence. These individuals killed young males between 15 and 24 years by kicking/hitting following a fight or dispute. Our results are consistent with studies reporting fights or arguments as common precursors to murder among offenders with personality disorder or alcohol dependence (Häkkinen & Laajasalo, 2006; Putkonen et al., 2001). Previous studies have also shown the offender's personality disorder as a strong predictor for using kicking or hitting to kill the victim (Häkkinen & Laajasalo, 2006) and that offenders with personality disorder or alcohol dependence are more likely to kill an acquaintance (Häkkinen & Laajasalo, 2006; Rodway et al., 2009). Hence it is possible that the fight or dispute that led to the homicide was with a young male known to the offender. Future research may build upon the present results and investigate the frequency with which young male victims of offenders with personality disorder or alcohol dependence, killed by kicking or hitting following a fight or dispute, were known prior to the crime. Unfortunately, this level of detail was beyond the means of the current study.

Second, as hypothesised, schizophrenia associated with a pattern describing domestic homicide: *intimate female homicide* pattern. These individuals killed older females using strangulation following a domestic dispute or irrational act. Contrary to previous findings, schizophrenia did not associate with the use of sharp instruments (Hughes et al, 2012). Possibly due to the high prevalence of sharp instrument use within our sample (54%). However, research on homicidal strangulation has shown up to 75% of victims are females (Häkkinen, 2005; 2007; ONS, 2017). Moreover, previous research has focused on direct relationships between homicide method and a mental illness per se (Minero et al., 2017) and do not account for circumstance surrounding the offence and type of victim. This pattern is consistent with previous research on adult family homicide reporting schizophrenia as the most prevalent diagnosis (Oram et al., 2013). Thus, our findings suggest the previously reported association between schizophrenia and sharp instruments may differ in cases where the victim is female, over 55 years and the homicide is preceded by a domestic dispute. Future research may examine the frequency to which offenders with schizophrenia use strangulation as a homicide method to kill an older female relative.

Third, we had anticipated that the affective disorders of bipolar and depression would each associate with different homicide patterns, namely a pattern of family/partner homicide and child homicide, respectively (see Minero et al., 2017). As hypothesised, depressive illness was associated with the *child homicide* pattern. Offenders corresponding to this pattern used the homicide methods drowning/suffocation/asphyxiation to kill a victim between 0 and 14 years in the context of child abuse. This is consistent previous studies reporting that children are at high risk of becoming victims of offenders with major depression or in a depressive state (Catanesi et al., 2011; Yoon et al., 2012). Against expectation, bipolar disorder also associated with the *child homicide* pattern. However, the hypothesis was partially supported

since death by suffocation was part of this pattern. A possible explanation is a similar mental state of offenders with bipolar disorder and depression at the time of the homicide (Benezech & Bourgeois, 1992; Minero et al., 2017; Yoon et al., 2012). Indeed, previous evidence showed a higher homicide rate in the depressive phase as opposed to the manic phase of bipolar disorder. Moreover, individuals with bipolar disorder in a depressive state were more likely to have children as victims compared to those experiencing a manic state at the time of the homicide (Yoon et al., 2012). Thus, this pattern suggests active symptoms may be more influential regarding differences in offending patterns than the psychiatric diagnosis of the individual. Our finding is consistent with previous research by reporting perpetrators with affective disorders who use drowning/suffocation/asphyxiation are more likely to kill younger victims (under 25 years) than older victims (Rodway et al., 2009).

A possible explanation for the association between the *male conflict homicide* pattern and personality disorder, alcohol and drug dependence diagnoses may be the high comorbidity of personality disorders and substance misuse (Walter, 2015), as well as aggressive and impulsive behaviours often reported among individuals with personality disorders (Moeller & Dougherty, 2001). Indeed, homicides associated with these diagnoses were preceded by fights or arguments. The association between schizophrenia and *female intimate homicide* may be related to a small subgroup of individuals with schizophrenia who engage in lethal violence against those who care for them (Hodigns, 2008). The association between affective disorders and the *child homicide* pattern may be explained by the high prevalence of these diagnoses among female homicide offenders who commit filicide (Flynn, 2013).

A strength of our study is that selection of variables used for analysis concern those available at the crime scene and do not include offender characteristics revealed later in the investigation (e.g. Goodwill et al., 2014); this is useful for homicide police investigations in which only crime scene information is available. Another strength of the present study is the comprehensive sample of homicide perpetrators with mental illness provided by the 17-year period of monitoring by the NCISH dataset. However, there are a number of limitations to our research. First, we only included information concerning the primary victim due to the small number of homicides with two or more victims ($n=24$); this may lead to bias depending on the order in which victim information was entered in the Homicide Index database. However, previous studies have also mainly focused on single offender-single victim homicides (Salfati & Canter, 1999). Second, only offenders with psychiatric reports were selected for our analysis, however courts are more likely to request a psychiatric report if there is evidence of severe mental illness. Thus, bias may have been introduced towards those offenders with severe mental illness (schizophrenia, bipolar disorder and major depression). Third, our sample is not representative of all individuals with mental illness who committed homicide. Indeed, the sample does not include people who had a mental illness at the time of the offence but were not under the care of mental health services in the year before the offence nor does it include recent mental health patients who did not have a psychiatric assessment following the offence. Fourth, information on specific types of personality disorder was not available in the data. It is important to mention previous studies using data from the Homicide Index have highlighted issues on the way in which homicide is described in the Homicide Index, indicating the variable 'circumstance of the homicide' is not as insightful as may be expected (Francis et al., 2004). Finally, it is crucial to acknowledge possible culture-specific

patterns in homicidal behaviour. Studies on crime scene analysis used as comparable data in our study derive mostly from the UK, Finland and the USA.

Although homicides by people with mental illness are rare, our findings may be useful in informing violence risk assessment as we have shown evidence for associations between offence characteristics patterns and specific psychiatric diagnoses. Moreover, findings provide information on offender psychopathology that may potentially assist homicide investigations as we identified which specific homicide patterns may be more prone to offenders with a particular mental illness. We plan to test the validity of the patterns identified in the present study by investigating the frequency in which each homicide case belonging to a specific pattern will associate with the corresponding diagnosis.

5. Conclusions

More attention should be paid to the role of offenders' psychopathology with regard to the manner in which a homicide is committed in order to identify possible differences between individuals that commit the same type of crime in different ways (Häkkinen, 2007). The current study analysed the underlying structure of 24 homicide offence characteristics to examine potential associations with the offenders' psychiatric diagnosis. Our study identified three distinct homicide patterns: *male conflict homicide*, *intimate female homicide* and *child homicide*. Each pattern associated with different psychiatric diagnoses: personality disorder/alcohol and drug dependence, schizophrenia and affective disorders respectively. Our findings suggest the possibility of predicting offender clinical characteristics from aspects of the offence, concurring with studies that have pursued predicting offender background characteristics based on the structure of crime scene information (Canter, 2000; Salfati, 2000).

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Tables

Table 1. Background and clinical information of individuals with a psychiatric report and in contact with mental health services in the 12 months before committing homicide, 1997-2014.

	Homicide Offenders with Mental Illness (n=759)	
	n	%
Background offender information		
Single	387	51
Married	205	27
Living with partner/fam	189	25
Living alone	167	22
Unemployed	485	64
Previous convictions	493	65
Previous homicide	8	1
GBH	82	12
Violence against a person	342	46
Sexual offences	29	4
Criminal damage (including arson)	282	38
Lifetime history of alcohol misuse	455	60
Lifetime history of drug misuse	508	67
Mental illness at the time of the homicide	380	56
Psychiatric diagnosis		
Schizophrenia and other delusional disorders	260	36
Personality disorder	130	18
Bipolar disorder	32	4
Depression	67	9
Alcohol dependence	75	10
Drug dependence	74	10
Other disorder ¹	85	12
Missing	36	4

Note: ¹Includes anxiety/phobia, dementia, adjustment disorder, organic disorder, learning disability, pervasive development disorder/autism, ADHD/conduct disorder and other disorder.

Table 2. Homicide offence characteristics included in joint correspondence analysis (n=759)

Homicide categories	n	%
Victim age groups		
Victim 0-14	51	7
Victim 15-24	86	11
Victim 25-34	117	15
Victim 35-44	173	23
Victim 45-54	137	18
Victim over 55	195	26
Victim gender		
Male	447	59
Female	312	41
Method of homicide		
Blunt instrument	74	10
Drowning/suffocation/asphyxiation	35	5
Kicking/hitting	89	12
Strangulation	51	8
Sharp instrument	412	54
Poisoning ¹	15	2
Arson/death by fire	26	3
Other/unknown ²	57	7
Main circumstance of homicide		
Infidelity/jealousy	37	5
Resulting from another crime ³	34	4
Child abuse	20	3
Fights/arguments/long running disputes	158	21
Irrational act ⁴	179	23
Domestic dispute	82	11
Sexual	15	2
Other/unspecified ⁵	234	31

Note: ¹Poisoning by drugs, but not carbon monoxide poisoning (exhaust fumes). ²Includes causing to fall against a hard surface, negligence or neglect, shooting, and struck by vehicle. ³Includes robbery, burglary and arson. ⁴Defined by Homicide Index as 'homicide committed by insane or disturbed individual' (ONS, 2017). ⁵Includes arising from separation, financial gain; mercy killing; motor vehicle; prevent victim informing/testifying; rage; while resisting arrest; other; unspecified; and unknown (contained in Homicide Index).

Figure legends

Figure 1: Joint correspondence analysis map of 24 homicide offence characteristics

Figure 2: Position of psychiatric diagnoses in analysis structure